Title: Dual n-gamma Measurement of the 235U(n,3n) Cross Section

Author(s): Kelly, Keegan John
Mosby, Michelle A.
Kawano, Toshihiko

Intended for: 2021 LDRD-DR Pitch Town Hall

Issued: 2021-10-05

Los Alamos NATIONAL LABORATORY

PHYSICS SINCE 1943

Dual n-γ Measurement of the ^{235}U(n,3n) Cross Section

Keegan Kelly (P-3, Presenting),

Michelle Mosby (XTD-NTA), Toshihiko Kawano (T-2)

October 5, 2021

Background

Context/Timeliness

- See Impact/Strategic Relevance section.
- The detector array intended for use in this proposal will reach maturity at exactly the time of the proposed ^{235}U measurement.

Knowledge Gap

- ^{235}U$(n,3n)$ cross section is poorly known.
- Data capable of yielding the proposed types of cross sections will be available, but the methods of extracting need to be developed.

Innovation

- Applying dual n-γ detection analysis with newly-available CLYC detectors.
- Array of CLYC detectors is currently being developed and built under LDRD project 20210329ER, which will reach the full- or near-full-scale design during the second year of the proposed DR project. This is when the ^{235}U measurement would occur.
- Fully map the n-γ correlation space from $(n,2n)$ and $(n,3n)$ reactions, which has never been measured before.
- New, independent method of extracting highly-desirable cross sections.

Research Approach

Hypothesis/Science Question

- Can we develop methods to extract $(n,2n)$ and $(n,3n)$ cross sections from dual n-γ data obtained with a newly-developed highly-segmented array of CLYC detectors?

Strategic Collaborators

- Keegan Kelly, PI (P-3)
- Michelle Mosby, Co-PI (XTD-NTA)
- Toshihiko Kawano, Co-PI (T-2)

Methods

- Year 1: Leverage ^{197}Au and ^{238}U dual n-γ data collected with a mostly-complete CLYC detector array from LDRD project 20210329ER to develop methods to extract $(n,2n)$ and $(n,3n)$ cross sections, and define required experimental parameters for the ^{235}U measurement

- Year 2: Perform the ^{235}U measurement with the complete or near-complete CLYC detector array from project 20210329ER, taking experimental considerations from yr. 1 into account, and extract the ^{235}U$(n,3n)$ cross section.

- Year 3: Perform new evaluation of ^{235}U+n cross sections, and assess impact.

Strategic Impact

Pillar

- Weapons Systems

Transition Plan

- Following the conclusion of this LDRD project, we will have developed a capability which should be attractive to OES.

Impact/Strategic Relevance to LANL

- The capability to do these types of measurements is important to the weapons community. Details are available on request.
- LA-CP-21-00199, LA-CP-21-00273, LA-CP-21-00292, LA-CP-21-00413, and more.